TESTIMONY OF

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BEFORE

THE SUBCOMMITTEE ON WATER RESOURCES AND THE ENVIRONMENT
COMMITTEE ON TRANSPORTATION AND INFRASTRUCTURE
U.S. HOUSE OF REPRESENTATIVES

ON

COASTAL ECOSYSTEM RESTORATION ON THE GULF COAST AND THE RELATIONSHIP TO FLOOD PROTECTION AND WATER RESOURCES PLANNING

20TH OCTOBER 2005

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Mr. Chairman and Distinguished Members of the Committee:

Thank you for this opportunity to explore with you the relationships between ecosystem restoration and other water resources planning issues on the Gulf coast. I will specifically describe potential synergies and conflicts between restoration and both navigation and flood control, and will address the issue of sustainability of restored ecosystems in the face of sea-level rise and subsidence. The context for this discussion is the recent impacts of Hurricanes Katrina and Rita on the north central Gulf and how our response to these events can mesh with both our existing and future restoration, flood protection and navigation needs.

My expertise in this area is based on my training as a coastal geomorphologist at the University of Cambridge, specializing in the sediment dynamics of coastal wetlands, and almost twenty years of research on coastal marshes in Louisiana. I have authored scholarly publications on coastal wetland response to sea-level rise, and the effects of hydrologic change on marsh sustainability. I have also worked actively in restoration planning in Louisiana since the early 1990's and these efforts include my contributions as an author of the 'Coast 2050' report issued in 1998, and as a member of the Project Delivery Team for the Louisiana Coastal Area restoration plan. In addition, in recent years I have conducted research on coastal wetland restoration and participated in restoration planning in the Sacramento-San Joaquin Delta and San Francisco Bay. I live in Terrebonne Parish, Louisiana in the small town on Montegut.

As a Professor at the University of New Orleans my research on coastal ecosystems is currently funded by NOAA and the US Geological Survey. My work at the University on restoration planning in Louisiana has been supported the State of Louisiana as part of their local sponsorship of the US Army Corps of Engineers Louisiana Coastal Area study. The thoughts and opinions expressed here are my own and do not represent the views of the University or any of these agencies.

The Need for Coastal Ecosystem Restoration

The recent hurricane damage to our coast has heightened awareness of their fragility in the face of storm surge and wave action. But even prior to this hurricane season, many of our coastal ecosystems on the Gulf Coast were in need of restoration. Around the shores on Mobile Bay and the landward bays of Mississippi Sound the area of coastal marsh has progressively declined as natural shorelines have been replaced by bulkheads. Seagrass beds have diminished as runoff from coastal communities changes water quality in the shallow bays. Restoration of these areas was already necessary to maintain the productivity of the coastal ecosystem, and the livelihoods of many coastal communities. While temporary changes in water quality associated with storm passage are unlikely to exacerbate existing problems with seagrasses or oyster beds, the physical erosion of marsh shorelines which have evolved over thousands of years as sea-level has gradually risen and submerged the shoreline is not readily rebuilt without human intervention.

The dramatic erosion of barrier islands from Dauphin Island, AL to Cat Island, MS indicates to many a need to reinforce those shorelines but from the perspective of the ecosystem this is likely unnecessary. Natural processes will gradually bring sand back to beaches which are currently little more than exposed mud. The process is slow and dependent locally on the size of nearshore sand deposits but this process has been observed during many storms. This natural healing, however, does not re-position the barrier island in its former location and the landward 'rollover' continues as sand moved into back barrier bays becomes colonized by marsh. 'Restoration' in most cases here is usually to meet some societal use of the system rather than to rehabilitate the ecosystem.

Within coastal Louisiana, the existing need for restoration is well established. Land loss rates in excess of 25 square miles per year have been continuing for decades. Without additional restoration, over and above projects already built under the Breaux Act and the projected effects of the freshwater diversions at Caernarvon and Davis Pond, we project loss of an additional 500 square miles by 2050. The benefits of various restoration options in providing habitat for commercial species such as shrimp and oysters, as well as the waterfowl and recreational fish species has been documented in recent planning documents (e.g., www.lca.gov) and I will not elaborate here. However, I must emphasize that to allow further degradation of this important ecosystem, the delta of the sixth largest river in the world, means to deny our responsibility as stewards of the natural environment.

On the upper Texas coast, estuarine ecosystems are similarly degraded. Massive loss of seagrasses in Galveston Bay is still largely unexplained, and local hot spots of marsh loss are as dramatic as many in the coast of Louisiana. In the same area, detailed studies of how juvenile shrimp and blue crabs utilize coastal habitats show the importance of these degraded ecosystems to the commercial fisheries of the Gulf.

The productivity of these coastal ecosystems is tremendous and all across the Nation people recognize their value for seafood production, waterfowl habitat, ecotourism and many other uses directly related to the presence of complex patterns of barrier islands, bays and marshes. The problems identified in general here, and specifically in a myriad of case studies, show a clear need for restoration of ecosystem processes and the prevention of further degradation.

Ecosystem Restoration and Coastal Navigation: Conflict or Opportunity?

How many of the problems identified above result from the construction and maintenance of navigation channels through the coastal bays to onshore port facilities? When dredging occurs in these systems there is an obvious and immediate disturbance to the ecosystem. Shallow bay bottoms are lost, along with any present seagrasses or oyster beds. The footprint of such channels forever changes marshes and swamps to open water. These effects cannot be denied and for the most part along this coast, the habitat losses associated with the footprint of navigation channel dredging occurred decades ago.

<u>Changing Salinity Gradients</u>
As well as the footprint, a change in estuarine hydrodynamics – the daily balance between freshwater outflows and saltwater penetration – results from this channelization.

One of the best documented examples of this type of change is associated with the Houma Navigation Canal. When this channel was dredged, straight and deep, between the town of Houma, Louisiana and the Gulf of Mexico in the early 1960’s, there was an immediate increase in the annual amount of days that the Houma water plant experienced chloride levels greater than 250 mg/l. While the changes soon after construction of such channels can be dramatic, the effects are not progressive. The estuary reaches a new ‘equilibrium’ – the balance between salt and freshwater simply moves further inland. Yet, habitat loss is frequently the result – the change is simply too fast and too persistent for the ecosystem to adapt. In the Houma example, extensive cypress forests were lost to the saltwater after the construction of the navigation channel as they have little tolerance for salt.

These kinds of effects have been manifest across the Gulf coast as shipping channels have provided easy access for salt to penetrate the estuary, and the effects are particularly pronounced where navigation canals link the Gulf directly with freshwater systems. In some cases, the canals allow the salt to move further in but they also provide avenues for freshwater to leave the system more quickly than it would through shallower natural channels and bays. The ecosystems thus become subject to a more 'flashy' salinity gradient – salinity increases more quickly but also drains more quickly.

The potential role of such canals in distributing freshwater is also illustrated by the Houma Navigation Canal. Like most navigation channels in the Gulf coast, the Houma Navigation Canal links to the Gulf Intracoastal Waterway – a direct east-west link between coastal communities and ports – with the Gulf. As you know, levees along the Mississippi River have restrict freshwater inflows to Louisiana coastal wetlands but in this instance dredging of navigation canals has actually facilitated that freshwater flow. As discussed above, after the Canal was dredged in the 1960's saltwater penetrated further inland. However, the emergence of the Atchafalaya delta after the flood of 1973 and the construction of the Bayous Chene, Black and Boeuf project in the western Terrebonne basin in the early 1980's both changed the flows of Atchafalaya River waters into the Gulf Intracoastal Waterway to the east. The increased flow of freshwater toward Houma has, at least seasonally, altered the effect of the Houma Navigation Canal on the salinity gradient in Terrebonne Parish and now, in concert with the other navigation channels, it acts as a conduit for freshwater to nourish marshes in that area. The LCA plan calls for the proposed lock on the Houma Navigation Canal to be used to direct this freshwater source into areas of greater need, and to prevent its quick exit to the Gulf of Mexico.

<u>Using Dredged Material for Restoration</u>

Perhaps a more direct and widespread relationship between ecosystem restoration and navigation channels is the use of dredged material to create or nourish coastal marshes and barrier islands. With funds available through the Section 204 Continuing Authorities Program to support the transportation and containment of dredged material beyond that justified by the navigation project itself, the Corps, in partnership with local sponsors, has been able to contribute to restoration through its navigation mission.

Programs to beneficially use dredged material from the Houston Ship Channel have both increased the area of marsh in Galveston Bay and provided important habitat for fisheries species. Designs have been improved through experimentation such that techniques for placement, containment, planting and drainage all work to ensure the creation of functional habitat. These are not just piles of mud!

However, not all Corps Districts or local sponsors are as forward thinking as those in Galveston Bay. In the face of the need for ecosystem restoration outlined above, it is no longer acceptable for suitable dredged material to be placed in upland disposal sites, as it has been for many years in the Pascagoula. Sediment is simply too valuable a resource and the need for restoration is too great. The recent restoration project on Deer Island in Mississippi could be an important prototype for other such projects in this area.

The New Orleans District of the Corps has an active beneficial use program. Marsh creation adjacent to the Calcasieu Ship Channel and in the Atchafalaya Delta, for instance, have produced extensive marsh areas. Sediment is a limiting resource for restoration in Louisiana and it is essential that where continued navigation requires dredging, even in emergency circumstances, that the best use of that material is made. In coastal Louisiana, there is no higher purpose for much of this material than marsh restoration.

Future Navigation Improvements

Many of the effects of navigation channels described above occurred decades ago when we were less aware of the consequences, or considered them less important than we do now. Given our need for restoration, if new navigation projects are to be undertaken, then it is essential that lessons are learned from the past, and that to the maximum extent possible, not practicable, these impacts are avoided.

The success of many coastal restoration in the northern Gulf, especially those that involve wetland creation or re-nourishment, relies on the provision of a hydrologic regime that allows for healthy vegetative growth and regular flooding to allow juvenile fish and shrimp to access the habitat that provides. Dredging deep straight channels through this coast alters the local hydrology. The 1998 Coast 2050 plan for Louisiana calls for locks or other navigable hydrologic barriers to be placed at Sabine Pass and at Cameron on the Calcasieu Ship Channel. If we can develop restoration plans that provide for navigation while reversing ecosystem degradation, then there is simply no reason why we should not be implementing similar measures on any new navigation projects.

While locks or floodgates can mitigate the effects of navigation canals on estuarine salinity gradient, the footprint of the canal on the coast will always lead to habitat loss. All material from new navigation channels must be used to further our restoration needs, not simply to satisfy mitigation requirements.

We know too much to let the past repeat itself. We have improved our technologies and approaches – we know this is achievable. It is not simply the figment of some scientist’s imagination.

Ecosystem Restoration and Flood Protection

The Role of Barrier Islands

The need for more robust flood protection for our coastal communities has been vividly demonstrated in the recent weeks. Many have discussed the potential role of coastal wetlands as ‘buffers’ against storm surge. In coastal Louisiana, many local residents see the barrier islands as their first line of defense against hurricane storm surge and this feeling is common across the Gulf coast.

However, well documented studies of this effect on the Gulf coast are limited. Numerical modeling conducted as part of Louisiana barrier shoreline restoration studies in the mid-1990s’ showed that, in some parts of the coast, substantial barrier island restoration could result in storm surge reductions of 3-4 ft at some locations. This study considered two tracks for a Category 5 hurricane and the effects were greatest when the barrier shoreline restoration options provided both a high barrier and restricted openings between the estuary and Gulf. The effects shown by the models were lessened in parts of the coastal system which were more open to the Gulf with a less intact barrier shoreline system. These studies were conducted a decade ago. Improved modeling tools, better topographic information for the coast, and more documentation of storm surges from Hurricanes Andrew and Lilli as well as the 2005 storms should all be used in future modeling of these potential restoration effects.

The Role of Coastal Wetlands

The effect of extensive coastal wetlands in providing protection has also been reported in several studies. The Coast 2050 report includes observations of storm surge elevations from Hurricane Andrews impact on the Louisiana coast in 1992. Using several point measurements the report notes reduction in storm surge amplitude of 2.8 to 3.1 inches per linear mile of marsh or marsh and open water. These data are from one storm and are based on opportunistic measurements of water level relative to the storm track. While they may be illustrative of the effect of coastal wetlands in storm surge reduction, they are by no means definitive.

Some unpublished work suggests that during Category 4 and 5 storms the marshes and barrier islands are submerged to the point where they are ineffective at reducing the storm surge. Modeling studies of the change in coastal land loss on storm surge elevations in Terrebonne Parish suggests that at least locally storm surge for a Category 3 storm may have increased several feet since the 1950’s. However, the patterns are complex and determined by local hydrology and topography. It is difficult to generalize a ‘rule of thumb’ from these studies.

Future Needs

The way in which coastal landscapes interact with storm surge is clearly the key to understanding how ecosystem restoration and flood protection are linked in the future. Thus far, restoration planning in Louisiana has paid only lip service to this issue, describing the relationship in general terms. It is now essential to conduct detailed analysis of this relationship and identify the role of specific ecosystem components in determining the height of coastal floodwaters.

To meet the needs of the ecosystem, we may not need to predict the specific configuration of marshes and open water, swamps and forested ridges, barrier islands and bays resulting from our restoration actions. But if we seek to afford some measure of flood protection while restoring the ecosystem, then these specifics will likely be crucial.

There may be places where restoration is cheaper and easier than in others. But these may not be the places where we can get that added flood protection benefit. We must introduce this additional factor directly into our analysis of restoration solutions so that the effect of restoration on our ecosystem and our communities can be evaluated. This requires direct integration of our coastal planning. Project-by-project 'business as usual' approaches to water resources planning on the Gulf coast will not seek out these potential synergies.

Ecosystem Restoration in the face of Subsidence and Sea-Level Rise

Natural processes of sediment compaction and gradual sea-level rise can submerge marsh plants and swamp forests unless soil builds up to compensate and keep the elevation high enough for plants and trees to survive. Processes contributing to soil building include sediment deposition from rivers or by tides and storms, and the accumulation of organic material in the soil. Healthy plant growth and active sediment deposition are thus essential to the coastal ecosystem.

Louisiana's coastal wetlands have been subjected to high rates of relative sea-level rise for centuries due to subsidence associated with the compaction and dewatering of deltaic sediments. Some Louisiana marshes have adjusted, and still survive in areas where measured rates of relative sea-level rise from tide gauges are over 0.4 inches per year; but others are experiencing stress which may in part be driven by the relative sea-level rise. Some studies predict that in salt marshes with high sediment loading (such as the Pascagoula River, the Pearl River, and parts of Galveston Bay) marshes should be able to build to keep pace with relative sea-level rise of at most 0.5 in/yr. Global sea level factors are projected to result in a sea-level rise of approximately 8 inches by the year 2050. If high rates of subsidence continue this suggests that many Louisiana marshes may deteriorate markedly under future sea-level rise conditions as rates increase beyond their maximum ability to build substrate. However many of the studies of marsh response consider tidal flooding to be the primary determinant of sediment deposition. In Louisiana it is well documented that high water events associated with frontal passages, tropical storms and hurricanes, including Katrina and Rita, cause the delivery of most of the sediment that is currently deposited in coastal marshes and it is thus possible they can cope with even higher rates of subsidence and sea-level rise than existing modeling studies predict.

Recent studies have documented high rates of subsidence at benchmarks located along highways across the north central Gulf. Whether these rates of subsidence can be applied to the coastal wetlands is yet to be determined. However, we do know that many coastal marshes in Louisiana have survived high rates of subsidence in the late 20th century. Thus, if our coastal restoration efforts in the Gulf are based on natural process approaches that allow sediments to accumulate and marsh peats to accumulate, then our marshes will stand a fighting chance in the face of future sea-level rise.

Future Water Resources Planning

Most coastal communities on the north central Gulf depend directly on their environment. The coastal waters provide them a living directly through seafood harvest or indirectly as our ports and harbors support trade, energy supply, and shipbuilding. However, at times those very waters produce a threat to lives and property that stuns us all with its power.

The current coast is a mosaic of projects and plans – linked only by the waters that move between them and that ebb and flow each day. Hurricanes Katrina and Rita have decided for us that the coast will be different. The forces of the storm make no distinction in their impact as they erode barrier islands, infill coastal waterways, and overtop protective levees. Similarly, our response to the storm and our plans for the future should not distinguish based on prior authorizations, mission areas, or political boundaries.

We must apply our understanding of the coast - the sediment movement, the tidal flow, the migrations of birds and fish, the saltwater and the freshwater, and, yes, also the storms – to see how these processes can support our local communities and the Nation. Flood protection, navigation and ecosystem restoration are not mutually incompatible. But how we manage the landscape and invest our limited resources for one purpose can fundamentally constrain our actions toward another unless our vision for the coast sees all three together.

Thank you Mr. Chairman and members of the Committee. This concludes my testimony.